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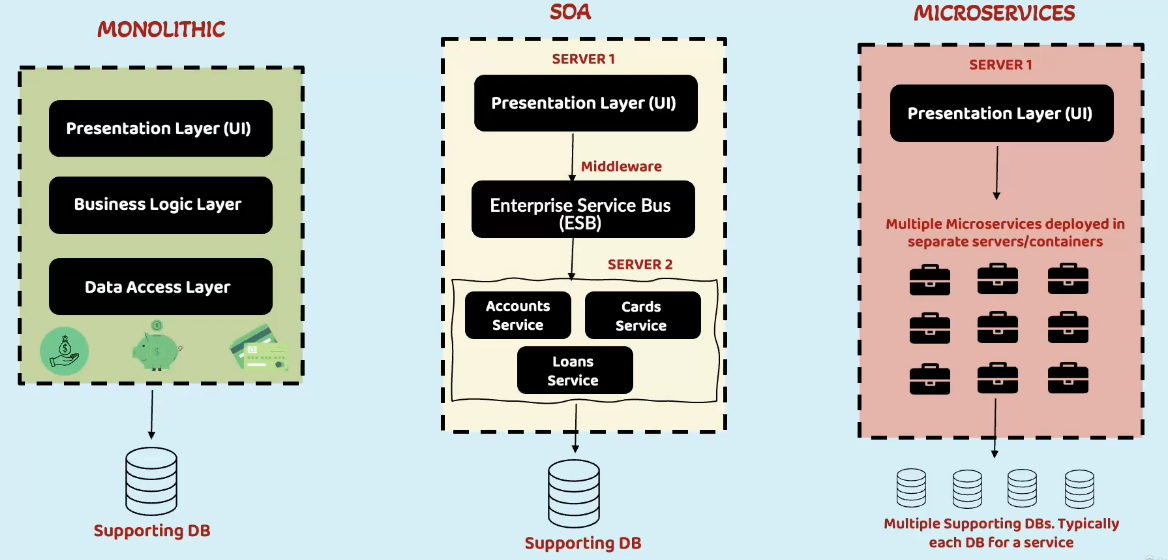
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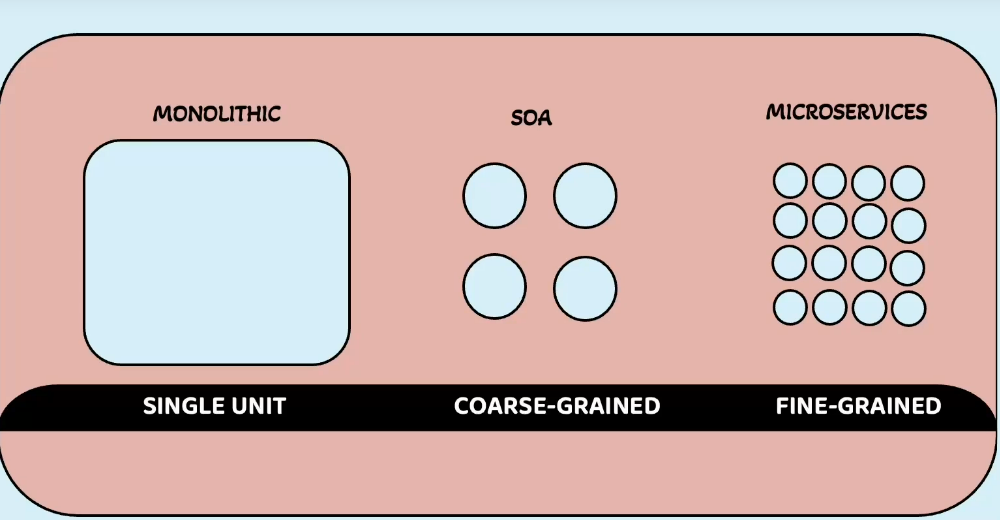
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Section 1  
Difference between Monolithic, SOA and Microservices  


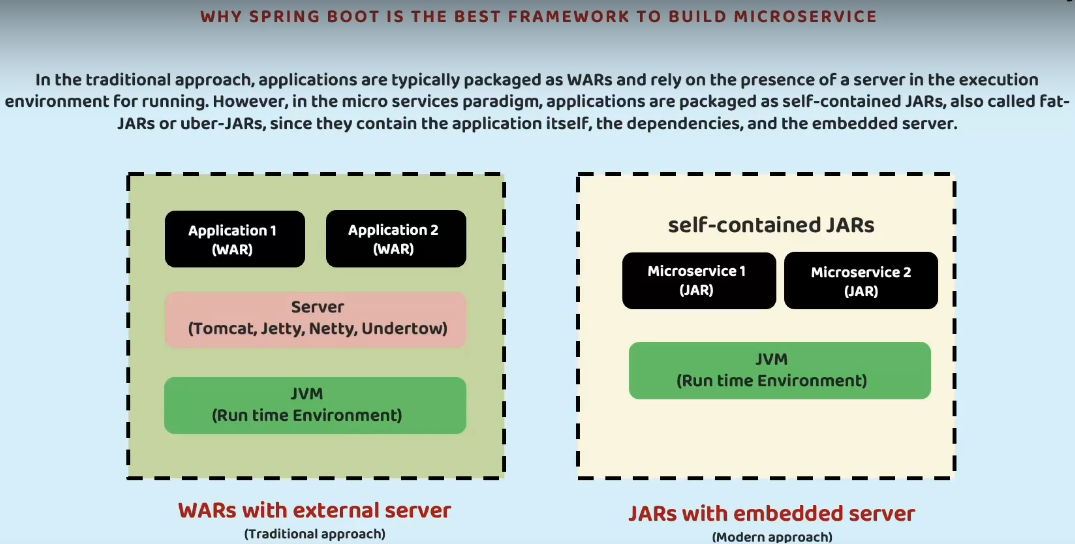
**Monolithic:**All applications will be deployed in a single server, supported by a single database.  
The web application and the business logic is tightly coupled.  
  
**SOA:**We separate the UI and the backend logic in different servers, but again supported by a single database.   
We add a middle ware extra component (Enterprise Service Bus - ESB) which is difficult to maintain.  
There is some level of separation but not based on business domain.  
  
**Microservice:**Here we create separate deployable services based on business domain and each has its own database. All these microservices and databases can be a mix of technology.   
So, each service has its own separate development, code base and deployment lifecycle.  
  


|  |  |  |  |
| --- | --- | --- | --- |
| **Features** | **Monolithic** | **SOA** | **Microservices** |
| Parallel development by teams on features which are component specific | NO | MIDDLE (separation between UI and backend teams) | YES |
| Agility (Enhancing the application or component with new language / framework) | NO | MIDDLE (separation between UI and backend teams) | YES |
| Scalability | NO - Not possible because you are going to deploy all your application in one single jumbo server, so to scale you bring in one more jumbo server and need to take care of load balancing – manual setup | MIDDLE – Difficult to scale you, as are going to deploy all your application in one single jumbo server. | YES – Scalability is easy, because of products like docker and Kubernetes. |
| Usability | NO | MIDDLE | YES – Any new feature specific for domain component can be deployed without any interference to any other component. |
| Complexity and Operational Overhead | YES – Here there is only one server, you have to make sure just that one server is running without any issues | MIDDLE – Here you need to take care of UI server, middle ware server and backend server. | NO |
| Security and Performance | YES – Here there use to be method calls | MIDDLE | NO – Here the communication between components/service are REST services, so request goes over the network. So there may be some network latency. |

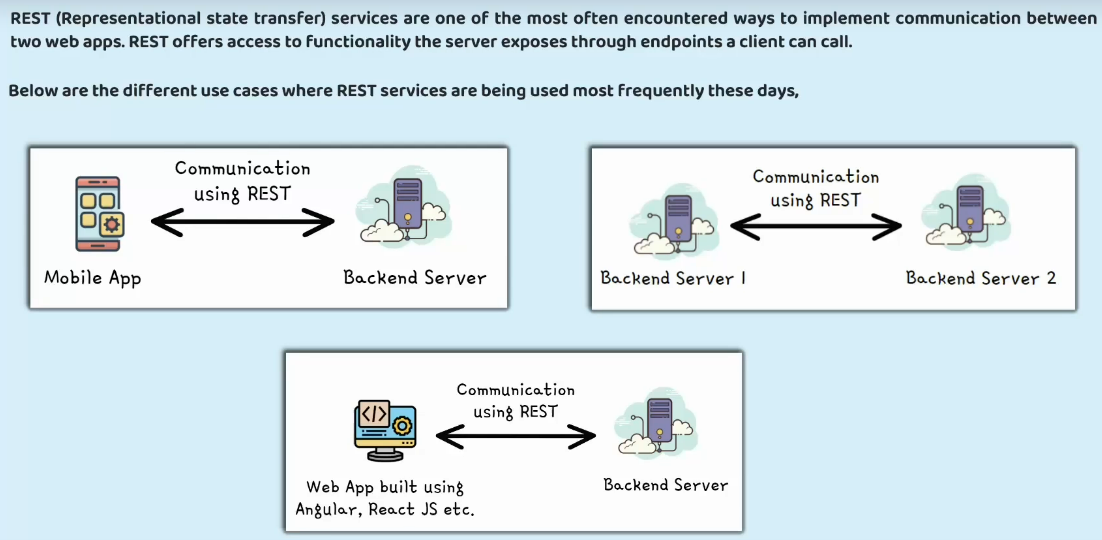
Definition of Microservices  


Section 2  
How to build Microservices  

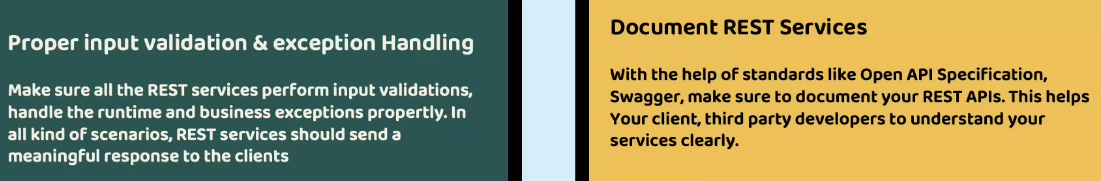


## Introduction to REST API and best practices







Creating Spring Boot project  
<parent>

        <groupId>org.springframework.boot</groupId>

        <artifactId>spring-boot-starter-parent</artifactId>

        <version>3.1.5</version>

</parent>

<groupId>com.eazybytes</groupId>

<artifactId>accounts</artifactId>

<version>0.0.1-SNAPSHOT</version>

<dependencies>

        <dependency>

            <groupId>org.springframework.boot</groupId>

            <artifactId>spring-boot-starter-actuator</artifactId>

        </dependency>

        <dependency>

            <groupId>org.springframework.boot</groupId>

            <artifactId>spring-boot-starter-data-jpa</artifactId>

        </dependency>

        <dependency>

            <groupId>org.springframework.boot</groupId>

            <artifactId>spring-boot-starter-validation</artifactId>

        </dependency>

        <dependency>

            <groupId>org.springframework.boot</groupId>

            <artifactId>spring-boot-starter-web</artifactId>

        </dependency>

        <dependency>

            <groupId>org.springframework.boot</groupId>

            <artifactId>spring-boot-devtools</artifactId>

            <scope>runtime</scope>

            <optional>true</optional>

        </dependency>

        <dependency>

            <groupId>com.h2database</groupId>

            <artifactId>h2</artifactId>

            <scope>runtime</scope>

        </dependency>

        <dependency>

            <groupId>org.projectlombok</groupId>

            <artifactId>lombok</artifactId>

            <optional>true</optional>

        </dependency>

    </dependencies>

import org.springframework.boot.autoconfigure.SpringBootApplication;  
With **@SpringBootApplication** annotation we are telling spring boot framework to perform auto configurations and to scan all the beans inside the spring boot application.  
So **@SpringBootApplication** is a combination of all these annotations   
@Inherited  
@SpringBootConfiguration  
@EnableAutoConfiguration  
@ComponentScan  
  
Creating Hello World REST API using @RestController   
Whenever we are putting an **@RestController** annotation on top of a class we are instructing the framework, that I am going to write method in this class related to http methods, so expose all these methods as a REST API to the outside world.  
  
package com.eazybytes.accounts.controller;

@RestController

public class AccountsController {

@GetMapping("sayHello")

public String sayHello(){

return "Say Hello";

}

}

Configuring H2 DB and yaml properties  
**accounts\src\main\resources\application.properties rename to application.yml**  
spring.datasource.url=jdbc:h2:mem:testdb

spring.datasource.driverClassName=org.h2.Driver

spring.datasource.username=sa

spring.datasource.password=

spring.jpa.database-platform=org.hibernate.dialect.H2Dialect

spring.h2.console.enabled=true

spring.jpa.hibernate.ddl-auto=update

spring.jpa.show-sql=true

server:

port: 8080

spring:

datasource:

url: jdbc:h2:mem:testdb

driver-class-name: org.h2.Driver

username: sa

password:

h2:

console:

enabled: true

jpa:

database-platform: org.hibernate.dialect.H2Dialect

hibernate:

ddl-auto: update

show-sql: true

**accounts\src\main\resources\schema.sql**CREATE TABLE IF NOT EXISTS `customer` (

`customer\_id` int AUTO\_INCREMENT PRIMARY KEY,

`name` varchar(100) NOT NULL,

`email` varchar(100) NOT NULL,

`mobile\_number` varchar(20) NOT NULL,

`created\_at` date NOT NULL,

`created\_by` varchar(20) NOT NULL,

`updated\_at` date DEFAULT NULL,

`updated\_by` varchar(20) DEFAULT NULL

);

CREATE TABLE IF NOT EXISTS `accounts` (

`customer\_id` int NOT NULL,

`account\_number` int AUTO\_INCREMENT PRIMARY KEY,

`account\_type` varchar(100) NOT NULL,

`branch\_address` varchar(200) NOT NULL,

`created\_at` date NOT NULL,

`created\_by` varchar(20) NOT NULL,

`updated\_at` date DEFAULT NULL,

`updated\_by` varchar(20) DEFAULT NULL

);

Start the spring application  
<http://localhost:8080/h2-console/>

You will see that the 2 tables are created ‘**customer’** and ‘**accounts’**.  
  
Writing Spring Data JPA Entities and Repositories to interact with DB tables

For this we have already added the library **spring-boot-starter-data-jpa** in which we have many interfaces and classes which we can use to interact with the database.  
  
Before using this framework, we need to create a POJO or Entity Classes which represent the tables in our database.  
  
CREATE TABLE IF NOT EXISTS `customer` (

`customer\_id` int AUTO\_INCREMENT PRIMARY KEY,

`name` varchar(100) NOT NULL,

`email` varchar(100) NOT NULL,

`mobile\_number` varchar(20) NOT NULL,

`created\_at` date NOT NULL,

`created\_by` varchar(20) NOT NULL,

`updated\_at` date DEFAULT NULL,

`updated\_by` varchar(20) DEFAULT NULL

);

CREATE TABLE IF NOT EXISTS `accounts` (

`customer\_id` int NOT NULL,

`account\_number` int AUTO\_INCREMENT PRIMARY KEY,

`account\_type` varchar(100) NOT NULL,

`branch\_address` varchar(200) NOT NULL,

`created\_at` date NOT NULL,

`created\_by` varchar(20) NOT NULL,

`updated\_at` date DEFAULT NULL,

`updated\_by` varchar(20) DEFAULT NULL

);

There are 4 columns which are common to each of these tables. These are called ***metadata columns***. So, these should have a separate super class **BaseEntity**.

`created\_at` date NOT NULL, so the field name should be createdAt  
`created\_by` varchar(20) NOT NULL, so the field name should be createdBy  
So no need to mention @Column(name=”created\_at”) for fields

By doing this we do not have the need to tell the framework which column this field maps to.  
  
**@MappedSuperclass** this signify that this entity class will act the super class for all you entity classes.  
  
**@Column**(**updatable** = false) when the row is being updated we don’t want this column to be considered by spring data JPA for updating, this fields/columns will not be updated whenever we update the record. It will be populated only once when the record is inserted or created.  
  
**@Column(insertable** = false) this tells do not populate this column whenever a new record is inserted or created.  
  
package com.eazybytes.accounts.entity;

import jakarta.persistence.MappedSuperclass;

@MappedSuperclass

@Getter @Setter @ToString

public class BaseEntity {

@Column(updatable = false)

private LocalDateTime createdAt;

@Column(updatable = false)

private String createdBy;

@Column(insertable = false)

private LocalDateTime updatedAt;

@Column(insertable = false)

private String updatedBy;

}

**@Entity** this is telling the JPA framework please treat this class as entity or POJO representation of the table ‘customer’. Table name should match with the class name Customer.

If it does not match you can use annotation @Table(name=”customer”) on top of the Entity class.  
  
**@AllArgsConstructor @NoArgsConstructor** these are required when we try to create the object of this class.  
  
**@Id** is used to signify the primary key of the table, but are we going to provide the value to the primary key manually   
or  
we want the spring data framework to generate the value by itself when we try to insert a new record inside the table.

Here in this case, it is good to give the responsibility to the spring data framework. For this   
**@GeneratedValue(strategy = GenerationType.AUTO, generator = "native")**

**@GenericGenerator(name = "native", strategy = "native")**  
This tells the spring data framework generate the value automatically, With “**native**” strategy we are telling spring data framework, whatever database that I am using please try to generate the sequence number or the primary key value based upon the native style of my database.

package com.eazybytes.accounts.entity;

@Entity

@Getter @Setter @ToString @AllArgsConstructor @NoArgsConstructor

public class Customer extends BaseEntity{

**@Id**

**@GeneratedValue(strategy = GenerationType.AUTO,generator = "native")**

**@GenericGenerator(name = "native", strategy = "native")**

**@Column(name = "customer\_id")**

private Long customerId;

private String name;

private String email;

@Column(name = "mobile\_number")

private String mobileNumber;

}

For accountNumber which is the primary key we will have our own logic to generate the value. Because we don’t want the account number to start with 1, 2, etc... account numbers are usually 10 digit numbers.  
  
package com.eazybytes.accounts.entity;

@Entity

@Getter @Setter @AllArgsConstructor @NoArgsConstructor

public class Accounts extends BaseEntity{

**@Id**

**@Column(name = "account\_number")**

private Long accountNumber;

@Column(name = "account\_type")

private String accountType;

@Column(name = "branch\_address")

private String branchAddress;

}

Now we should also create the repository classes.  
Create package com.eazybytes.accounts.repository  
**@Repository** when we mention this annotation, *spring data JPA framework will create the bean implementation (runtime code having lots of methods for various sorts of CRUD operations) of this interface in the background based on the configurations that we provided in application.yml and this interface, extends JpaRepository<Customer, Long> so this represents which is the entity class which is going to be handled by this repository class and what is the datatype of your primary key*.

JpaRepository internally extends various interfaces ListCrudRepository, ListPagingAndSortingRepository, QueryByExampleExecutor   
  
package com.eazybytes.accounts.repository;

import org.springframework.data.jpa.repository.JpaRepository;

@Repository

public interface CustomerRepository extends JpaRepository<Customer, Long> {

}

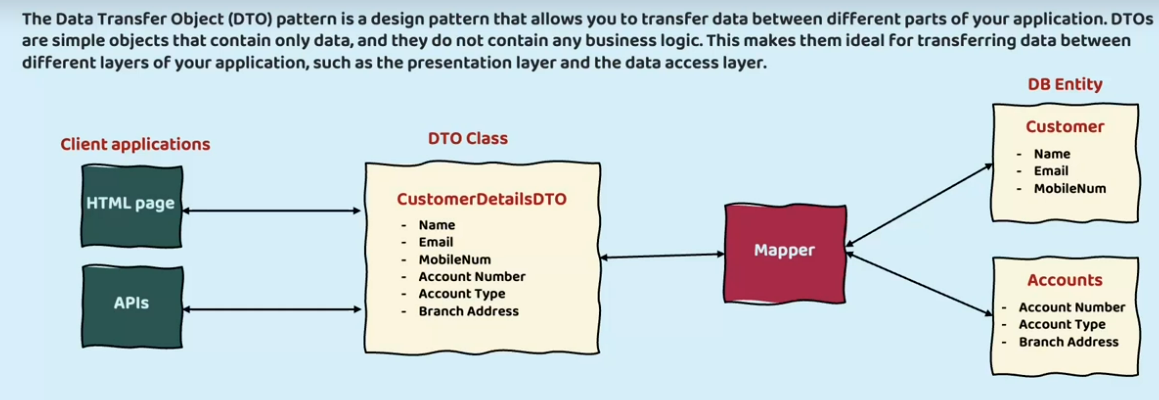
package com.eazybytes.accounts.repository;

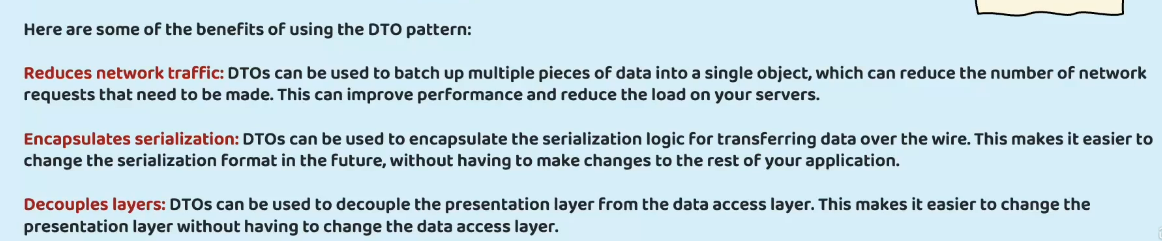
import org.springframework.data.jpa.repository.JpaRepository;

@Repository

public interface AccountsRepository extends JpaRepository<Accounts, String> {

}

Introduction to DTO (data transfer objects)  
So entity classes are used to create, update, delete accounts and customer detail or records inside a database.   
But what if a client application wants you accounts and customer details together in a single request. So, we cannot send 2 different objects inside a response, we can send only 1 single object inside a response.  
These entity classes are related to the database layer:  
  




Creating DTO’s inside accounts microservice  
create package com.eazybytes.accounts.dto  
  
**@Data** this not ***only creates the getters and setters but also the hashcode and equals methods***. But this ***does not create a constructor which accepts all fields as arguments***.   
  
package com.eazybytes.accounts.dto;

@Data

public class **AccountsDto** {

private Long accountNumber;

private String accountType;

private String branchAddress;

}

package com.eazybytes.accounts.dto;

@Data

public class **CustomerDto** {

private String name;

private String email;

private String mobileNumber;

}

package com.eazybytes.accounts.dto;

@Data @AllArgsConstructor

public class **ResponseDto** {

private String statusCode;

private String statusMsg;

}

package com.eazybytes.accounts.dto;

@Data @AllArgsConstructor

public class **ErrorResponseDto** {

private String apiPath;

private HttpStatus errorCode;

private String errorMsg;

private LocalDateTime errorTime;

}

## Create API inside accounts microservice – Part 1

Create a constants class as below  
package com.eazybytes.accounts.constants;

public final class AccountsConstants {

private AccountsConstants() {

// restrict instantiation

}

public static final String SAVINGS = "Savings";

public static final String ADDRESS = "123 Main Street, New York";

public static final String STATUS\_201 = "201";

public static final String MESSAGE\_201 = "Account created successfully";

public static final String STATUS\_200 = "200";

public static final String MESSAGE\_200 = "Request processed successfully";

public static final String STATUS\_417 = "417";

public static final String MESSAGE\_417\_UPDATE= "Update operation failed. Please try again or contact Dev team";

public static final String MESSAGE\_417\_DELETE= "Delete operation failed. Please try again or contact Dev team";

// public static final String STATUS\_500 = "500";

// public static final String MESSAGE\_500 = "An error occurred. Please try again or contact Dev team";

}

It is always recommended to maintain a prefix API path which is common to the rest API present inside your controller class.

@RestController

**@RequestMapping(path = "/api", produces = MediaType.APPLICATION\_JSON\_VALUE)**

public class AccountsController {  
 ….

}  
  
**@RequestBody** = Whatever the clients are sending in the request body the same will be mapped into the POJO class that we mention.

package com.eazybytes.accounts.controller;

@RestController

@RequestMapping(path = "/api", produces = MediaType.APPLICATION\_JSON\_VALUE)

public class AccountsController {

@PostMapping("/create")

public ResponseEntity<ResponseDto> createAccount(@RequestBody CustomerDto customerDto)

{

return ResponseEntity

.status(HttpStatus.CREATED)

.body(new ResponseDto(AccountsConstants.MESSAGE\_201, AccountsConstants.MESSAGE\_201));

}

}

The business logic should always be in a service layer,   
the Controller layer should only   
a. **accept** the request and send the response.

b. **perform** any validations

Create package com.eazybytes.accounts.service  
package com.eazybytes.accounts.service;

public interface IAccountsService {

void createAccount(CustomerDto customerDto);

}  
  
Create package com.eazybytes.accounts.service.impl  
**@Service** – *To indicate the spring framework that this class is going to act as a service layer so please create the bean and once the bean is created by the spring boot framework , we can auto wire that bean in the controller layer.*  
  
package com.eazybytes.accounts.service.impl;

@Service

public class AccountsServiceImpl implements IAccountsService {

@Override

public void createAccount(CustomerDto customerDto) {

throw new UnsupportedOperationException("Unimplemented method 'createAccount'");

}

}

Before we write the logic to create the account, auto wire the repository classes.  
@Service

@AllArgsConstructor

public class AccountsServiceImpl implements IAccountsService {  
….  
}  
***Because of @AllArgsConstructor it will create an all args constructor , so when we have only single constructor inside your class that is accepting parameters, you don’t need to auto wire these repository classes with the help of @Autowire.  
Spring framework will automatically do the auto wiring, since there is single all args constructor constructor.***

package com.eazybytes.accounts.service.impl;

@Service

@AllArgsConstructor

public class AccountsServiceImpl implements IAccountsService {

private AccountsRepository accountsRepository;

private CustomerRepository customerRepository;

@Override

public void createAccount(CustomerDto customerDto) {

throw new UnsupportedOperationException("Unimplemented method 'createAccount'");

}

}  
  
Now when we save the details of the customer we need to sends the object of Customer entity object and not the DTO class object. So, there should be some mapping logic to convert the DTO to entity object.

Create package com.eazybytes.accounts.mapper  
**These mapper classes will take the responsibility of converting the entity to DTO and DTO to entity.**  
package com.eazybytes.accounts.mapper;

public class **AccountsMapper** {

public static AccountsDto **mapToAccountDto**(Accounts accounts, AccountsDto accountsDto){

accountsDto.setAccountNumber(accounts.getAccountNumber());

accountsDto.setAccountType(accounts.getAccountType());

accountsDto.setBranchAddress(accounts.getBranchAddress());

return accountsDto;

}

public static Accounts **mapToAccounts**(AccountsDto accountsDto, Accounts accounts) {

accounts.setAccountNumber(accountsDto.getAccountNumber());

accounts.setAccountType(accountsDto.getAccountType());

accounts.setBranchAddress(accountsDto.getBranchAddress());

return accounts;

}

}  
   
package com.eazybytes.accounts.mapper;

public class **CustomerMapper** {

public static CustomerDto **mapToCustomerDto**(Customer customer, CustomerDto customerDto) {

customerDto.setName(customer.getName());

customerDto.setMobileNumber(customer.getMobileNumber());

customerDto.setEmail(customer.getEmail());

return customerDto;

}

public static Customer **mapToCustomer**(CustomerDto customerDto, Customer customer) {

customer.setName(customerDto.getName());

customer.setMobileNumber(customerDto.getMobileNumber());

customer.setEmail(customerDto.getEmail());

return customer;

}

}

There are libraries to do this mapping DTO to entity and entity to DTO automatically   
“modelmapper” and “mapStruct”

## Create API inside accounts microservice and Exception Handling – Part 2

customerRepository.save(customer);  
The customer\_id will be generated automatically by the spring data jpa framework. To know the customer\_id we should save the returned object in a Customer object.  
save method is coming from JpaRepository. All the boiler plate code is taken care by the spring data jpa framework.  
  
package com.eazybytes.accounts.service.impl;

@Service

@AllArgsConstructor

public class AccountsServiceImpl implements IAccountsService {

private AccountsRepository accountsRepository;

private CustomerRepository customerRepository;

@Override

public void createAccount(CustomerDto customerDto) {

Customer customer = CustomerMapper.mapToCustomer(customerDto, new Customer());

Customer savedCustomer = customerRepository.save(customer);

accountsRepository.save(createNewAccount(savedCustomer));

}

private Accounts createNewAccount(Customer customer) {

Accounts newAccount = new Accounts();

newAccount.setCustomerId(customer.getCustomerId());

long randomAccntNUmber = 1000000000L + new Random().nextInt(900000000);

newAccount.setAccountNumber(randomAccntNUmber);

newAccount.setAccountType(AccountsConstants.SAVINGS);

newAccount.setBranchAddress(AccountsConstants.ADDRESS);

return newAccount;

}

}

Create package for all exception handling classes com.eazybytes.accounts.exception  
public class **CustomerAlreadyException** extends RuntimeException {

….}  
**Any exception that you create should extend RuntimeException.**  
public CustomerAlreadyException(String message) {

super(message);

}  
Whenever anyone is trying to create an object of this Exception class with the message value the same message, we are passing to the Runtime Exception because we are extending this as a super class.

@ResponseStatus(value = HttpStatus.BAD\_REQUEST)  
This annotation is there because whenever this exception is thrown the client will get the message or response as BAD\_REQUEST.

package com.eazybytes.accounts.exception;

**@ResponseStatus(value = HttpStatus.BAD\_REQUEST)**

public class CustomerAlreadyException extends RuntimeException {

public CustomerAlreadyException(String message) {

super(message);

}

}

Now integrate this custom exception in the service class.  
But the duplicate customer cannot be found by the customer\_id since the NEW/FRESH incoming request does not have the customer\_id, we have to identify the duplicate/existing customer using mobile number, so we need to find a customer with same mobile number if a customer exists with the incoming request mobile number it will treated as an existing customer.

package com.eazybytes.accounts.repository;

@Repository

public interface CustomerRepository extends JpaRepository<Customer, Long>{

Optional<Customer> findByMobileNumber(String mobileNumber);

}  
  
package com.eazybytes.accounts.service.impl;

@Service

@AllArgsConstructor

public class AccountsServiceImpl implements IAccountsService {

private AccountsRepository accountsRepository;

private CustomerRepository customerRepository;

@Override

public void createAccount(CustomerDto customerDto) {

Customer customer = CustomerMapper.mapToCustomer(customerDto, new Customer());

Optional<Customer> optionalCustomer = customerRepository.findByMobileNumber(customerDto.getMobileNumber());

if(optionalCustomer.isPresent()) {

throw new CustomerAlreadyException("Customer already registered with given mobile number: "+ customerDto.getMobileNumber());

}

Customer savedCustomer = customerRepository.save(customer);

accountsRepository.save(createNewAccount(savedCustomer));

}

…

}

But where is the logic to handle this exception, this method is called from the parent method which is in Controller.  
We can have a catch block and throw the expected message to the client but what if we need to throw and catch the same exception in some other controller or method, so it will be code duplication.  
  
To avoid this we need to write a **GlobalException handling logic**.  
  
package com.eazybytes.accounts.exception;

import org.springframework.web.bind.annotation.ControllerAdvice;

@ControllerAdvice

public class GlobalExceptionHandler {

}  
  
**@ControllerAdvice** – Using ***this annotation we are telling the spring boot framework whenever any exception happens in any of my controller in all such controllers, please invoke a method that I am going to write in this class.***

***But the question is how the spring boot framework will know that this method needs to be invoked when this exception is thrown.   
This is done by the annotation*** **@ExceptionHandler(CustomerAlreadyException.class)**

@ExceptionHandler(CustomerAlreadyException.class)

public ResponseEntity<ErrorResponseDto> handleCustomerAlreadyException(CustomerAlreadyException exception,

WebRequest webRequest)

{

….

}

package com.eazybytes.accounts.exception;

import org.springframework.web.bind.annotation.ControllerAdvice;

import org.springframework.web.bind.annotation.ExceptionHandler;

import org.springframework.web.context.request.WebRequest;

import com.eazybytes.accounts.dto.ErrorResponseDto;

@ControllerAdvice

public class GlobalExceptionHandler {

@ExceptionHandler(CustomerAlreadyException.class)

public ResponseEntity<ErrorResponseDto> handleCustomerAlreadyException(CustomerAlreadyException exception,

WebRequest webRequest)

{

ErrorResponseDto errorResponseDto = new ErrorResponseDto(

webRequest.getDescription(false),

HttpStatus.BAD\_REQUEST,

exception.getMessage(),

LocalDateTime.now());

return new ResponseEntity<>(errorResponseDto, HttpStatus.BAD\_REQUEST);

}

}  
  
  
Let’s fix and update the Controller class now.  
Autowire the IAccountsService we can do **field auto wiring by mentioning @Autowired**, but we can also do **Constructor auto wiring by mentioning @AllArgsConstructor**.  
**NOTE:** Whenever we have a single all args constructor we do not need to mention @Autowired.  
  
package com.eazybytes.accounts.controller;

@RestController

@RequestMapping(path = "/api", produces = MediaType.APPLICATION\_JSON\_VALUE)

@AllArgsConstructor

public class AccountsController {

private IAccountsService iAccountsService;

@PostMapping("/create")

public ResponseEntity<ResponseDto> createAccount(@RequestBody CustomerDto customerDto)

{

iAccountsService.createAccount(customerDto);

return ResponseEntity

.status(HttpStatus.CREATED)

.body(new ResponseDto(AccountsConstants.MESSAGE\_201, AccountsConstants.MESSAGE\_201));

}

}

Update the createdAt and CreatedBy  
package com.eazybytes.accounts.service.impl;

@Service

@AllArgsConstructor

public class AccountsServiceImpl implements IAccountsService {

private AccountsRepository accountsRepository;

private CustomerRepository customerRepository;

@Override

public void createAccount(CustomerDto customerDto) {

Customer customer = CustomerMapper.mapToCustomer(customerDto, new Customer());

Optional<Customer> optionalCustomer = customerRepository.findByMobileNumber(customerDto.getMobileNumber());

if(optionalCustomer.isPresent()) {

throw new CustomerAlreadyException("Customer already registered with given mobile number: "+ customerDto.getMobileNumber());

}

**customer.setCreatedAt(LocalDateTime.now());**

**customer.setCreatedBy("Anonymous");**

Customer savedCustomer = customerRepository.save(customer);

accountsRepository.save(createNewAccount(savedCustomer));

}

…

}

POST http://localhost:8080/api/create  
  
{

    "name": "Madan Reddy",

    "email": "tutor@eazybytes",

    "mobileNumber": "9823150966"

}

Read API inside accounts microservice and Exception Handling  
This is an endpoint to which when we pass a mobile number it gets all the information about the customer and account.  
When we do this operation there is very high chance that there is no customer or account for the given mobile number so in that case, we throw ResourceNotFoundException.   
  
package com.eazybytes.accounts.exception;

@ControllerAdvice

public class GlobalExceptionHandler {

…

@ExceptionHandler(ResourceNotFoundException.class)

public ResponseEntity<ErrorResponseDto> handleResourceNotFoundException(ResourceNotFoundException exception,

WebRequest webRequest)

{

ErrorResponseDto errorResponseDto = new ErrorResponseDto(

webRequest.getDescription(false),

HttpStatus.NOT\_FOUND,

exception.getMessage(),

LocalDateTime.now());`

return new ResponseEntity<>(errorResponseDto, HttpStatus.NOT\_FOUND);

}

}

Once we are ready with the resource not found exception handling lets update the AccountServiceImpl

package com.eazybytes.accounts.repository;

@Repository

public interface AccountsRepository extends JpaRepository<Accounts, Long> {

Optional<Accounts> findByCustomerId(Long customerId);

}

We do not have a method to fetch a customer by mobile number so we add one

package com.eazybytes.accounts.repository;

@Repository

public interface CustomerRepository extends JpaRepository<Customer, Long>{

Optional<Customer> findByMobileNumber(String mobileNumber);

}  
  
We need to send the Account details along with Customer details to we have 2 options:  
Option 1: Create new DTO CustomerAccountDto embed CustomerDto and AccountDto in it.  
Option 2: Embed AccountsDto on CustomerDto  
**Option 1 is preferred approach**

package com.eazybytes.accounts.dto;

@Data

public class CustomerDto {

private String name;

private String email;

private String mobileNumber;

**private AccountsDto accountsDto;**

}

package com.eazybytes.accounts.service;

public interface IAccountsService {

void createAccount(CustomerDto customerDto);

CustomerDto fetchAccount(String mobileNumber);

}

Update the AccountsServceImpl and add a function to **fetchAccount**,   
\* fetch customer using mobile number and   
\* fetch accounts using customerId (get customerId from the customer fetched above)  
  
package com.eazybytes.accounts.service.impl;

@Service

@AllArgsConstructor

public class AccountsServiceImpl implements IAccountsService {

private AccountsRepository accountsRepository;

private CustomerRepository customerRepository;

…

@Override

public CustomerDto fetchAccount(String mobileNumber) {  
 **fetch customer**

Customer customer = customerRepository.findByMobileNumber(mobileNumber).orElseThrow(

() -> new ResourceNotFoundException("Customer", "mobileNumber", mobileNumber)

);  
 **fetch accounts**

Accounts accounts = accountsRepository.findByCustomerId(customer.getCustomerId()).orElseThrow(

() -> new ResourceNotFoundException("Account", "customerID",customer.getCustomerId().toString())

);

CustomerDto customerDto = CustomerMapper.mapToCustomerDto(customer, new CustomerDto());

customerDto.setAccountsDto(AccountsMapper.mapToAccountDto(accounts, new AccountsDto()));

return customerDto;

}

}

Update AccountsController to add the endpoint function fetchAccountDetails

package com.eazybytes.accounts.controller;

@RestController

@RequestMapping(path = "/api", produces = MediaType.APPLICATION\_JSON\_VALUE)

@AllArgsConstructor

public class AccountsController {

private IAccountsService iAccountsService;

…

@GetMapping("/fetch")

public ResponseEntity<CustomerDto> fetchAccountDetails(@RequestParam String mobileNumber){

CustomerDto customerDto = iAccountsService.fetchAccount(mobileNumber);

return ResponseEntity

.status(HttpStatus.OK)

.body(customerDto);

}

}  
  
GET <http://localhost:8080/api/fetch?mobileNumber=9823150966>

Update API inside accounts microservice and Exception Handling  
Update endpoint will allow our client to update the account details in our database.  
{

    "name": "Madan Reddy",

    "email": "tutor@eazybytes",

    "mobileNumber": "9823150966",

    "accountsDto": {

        "accountNumber": 1098248735,

        "accountType": "Savings",

        "branchAddress": "123 Main Street, New York"

    }

}

They can change any of this data except account number.

Add 500 to the AccountsConstants  
package com.eazybytes.accounts.constants;

public final class AccountsConstants {

….  
 public static final String STATUS\_500 = "500";

public static final String MESSAGE\_500 = "An error occurred. Please try again or contact Dev team";

}

Add the update abstract function to the interface IAccountsService

package com.eazybytes.accounts.service;

public interface IAccountsService {

…

boolean updateAccount(CustomerDto customerDto);

}

Implement the interface function  
package com.eazybytes.accounts.service.impl;

@Service

@AllArgsConstructor

public class AccountsServiceImpl implements IAccountsService {

private AccountsRepository accountsRepository;

private CustomerRepository customerRepository;

…

@Override

public boolean updateAccount(CustomerDto customerDto) {

boolean isUpdated = false;

AccountsDto accountsDto = customerDto.getAccountsDto();

if(accountsDto != null) {

Accounts accounts = accountsRepository.findById(accountsDto.getAccountNumber()).orElseThrow(

() -> new ResourceNotFoundException("Account", "accountNumber", accountsDto.getAccountNumber().toString())

);

AccountsMapper.mapToAccounts(accountsDto, accounts);

accounts = accountsRepository.save(accounts);

Long customerId = accounts.getCustomerId();

Customer customer = customerRepository.findById(customerId).orElseThrow(

() -> new ResourceNotFoundException("Customer", "customerID", customerId.toString())

);

CustomerMapper.mapToCustomer(customerDto, customer);

customerRepository.save(customer);

isUpdated = true;

}

return isUpdated;

}

}

Add the update endpoint to the AccountsController

package com.eazybytes.accounts.controller;

@RestController

@RequestMapping(path = "/api", produces = MediaType.APPLICATION\_JSON\_VALUE)

@AllArgsConstructor

public class AccountsController {

private IAccountsService iAccountsService;

….

@PutMapping("/update")

public ResponseEntity<ResponseDto> updateAccountDetails(@RequestBody CustomerDto customerDto)

{

boolean isUpdated = iAccountsService.updateAccount(customerDto);

if(isUpdated) {

return ResponseEntity

.status(HttpStatus.OK)

.body(new ResponseDto(AccountsConstants.STATUS\_200, AccountsConstants.MESSAGE\_200));

} else {

return ResponseEntity

.status(HttpStatus.INTERNAL\_SERVER\_ERROR)

.body(new ResponseDto(AccountsConstants.STATUS\_500, AccountsConstants.MESSAGE\_500));

}

}

}  
  
PUT <http://localhost:8080/api/update>

{

    "name": "Madanlal Reddy",

    "email": "tutor1@eazybytes",

    "mobileNumber": "9823150966",

    "accountsDto": {

        "accountNumber": 1001102837,

        "accountType": "Current",

        "branchAddress": "1234 Main Street, New York"

    }

}

Delete API inside accounts microservice and Exception Handling  
  
accountsRepository.deleteByCustomerId(customer.getCustomerId());  
This method is not from the framework, so we need to handle the transaction.   
***@Transactional***

***@Modifying == This tells the spring data framework that this method is going to update the data so please execute the query inside a transaction. So if there is error in executing the query the partial query will be rolled back.***  
customerRepository.deleteById(customer.getCustomerId());  
**This method is from the framework, so the framework will take care of executing the query in this method in a transaction.**  
  
package com.eazybytes.accounts.service;

public interface IAccountsService {

….

boolean deleteAccount(String mobileNumber);

}

package com.eazybytes.accounts.repository;

mport org.springframework.data.jpa.repository.Modifying;

import jakarta.transaction.Transactional;

@Repository

public interface AccountsRepository extends JpaRepository<Accounts, Long> {

…

@Transactional

@Modifying

void deleteByCustomerId(Long customerId);

}

package com.eazybytes.accounts.service.impl;

@Service

@AllArgsConstructor

public class AccountsServiceImpl implements IAccountsService {

private AccountsRepository accountsRepository;

private CustomerRepository customerRepository;

@Override

public boolean deleteAccount(String mobileNumber) {

Customer customer = customerRepository.findByMobileNumber(mobileNumber).orElseThrow(

() -> new ResourceNotFoundException("Customer", "mobileNumber", mobileNumber)

);

accountsRepository.deleteByCustomerId(customer.getCustomerId());

customerRepository.deleteById(customer.getCustomerId());

return true;

}

}  
  
  
  
package com.eazybytes.accounts.controller;

@RestController

@RequestMapping(path = "/api", produces = MediaType.APPLICATION\_JSON\_VALUE)

@AllArgsConstructor

public class AccountsController {

private IAccountsService iAccountsService;

…

@DeleteMapping("/delete")

public ResponseEntity<ResponseDto> deleteAccountDetails(@RequestParam String mobileNumber)

{

boolean isDeleted = iAccountsService.deleteAccount(mobileNumber);

if(isDeleted) {

return ResponseEntity

.status(HttpStatus.OK)

.body(new ResponseDto(AccountsConstants.STATUS\_200, AccountsConstants.MESSAGE\_200));

} else {

return ResponseEntity

.status(HttpStatus.INTERNAL\_SERVER\_ERROR)

.body(new ResponseDto(AccountsConstants.STATUS\_500, AccountsConstants.MESSAGE\_500));

}

}

}

## Handle all types of runtime exceptions using global logic inside accounts

Inside our GlobalExceptionHandler we are handling only 2 exceptions which are business exceptions or user defined exceptions.  
  
but you should be able to send proper response to the client application if any other exception happens inside our application.  
package com.eazybytes.accounts.exception;

@ControllerAdvice

public class GlobalExceptionHandler {

…

@ExceptionHandler(Exception.class)

public ResponseEntity<ErrorResponseDto> handleGlobalException(Exception exception,

WebRequest webRequest) {

ErrorResponseDto errorResponseDTO = new ErrorResponseDto(

webRequest.getDescription(false),

HttpStatus.INTERNAL\_SERVER\_ERROR,

exception.getMessage(),

LocalDateTime.now()

);

return new ResponseEntity<>(errorResponseDTO, HttpStatus.INTERNAL\_SERVER\_ERROR);

}

}  
  
The way this works is the spring boot framework is first look for handler functions which are with the exact exception details, if there is no such exception handler method then the logic inside **handleGlobalException** method is going to get executed.

this way our application is now ready to handle any type of exception. In Production we can add the logic inside this method to  
a. trigger an email  
b. make a table entry  
etc… for notification and reporting purpose.  
  
To test the is   
~~@AllArgsConstructor~~

public class AccountsController {  
…  
}  
  
Totest this Global Exception handler, Remove the @AllArgsConstructor hence the auto wiring will fail, because of no default all args constructor.

## Perform input data validations inside accounts microservice

Client applications pass various kind of data in the request, what if client is not following the proper data format for email, mobile number, account number, etc  
In most of the cases nothing wrong will happen, but we may end up calling the downstream components before failure, making DB queries, etc.

Hence it is necessary we are doing enough validations on the input data that we are receiving in the REST services.  
  
For this we need the spring boot starter dependency  
<dependency>

<groupId>org.springframework.boot</groupId>

<artifactId>spring-boot-starter-validation</artifactId>

</dependency>  
  
So the customer data is hold by the DTO classes in our project. So, spring boot must perform the validations on this data. These validations are configured using annotations on these DTO classes.  
  
package com.eazybytes.accounts.dto;

@Data

public class CustomerDto {

@NotEmpty(message = "Name cannot be null or empty")

@Size(min = 5, max = 30, message = "The length of the customer name should be between 5 and 30")

private String name;

@NotEmpty(message = "Email address cannot be null or empty")

@Email(message = "Email address should be a valid value")

private String email;

@NotEmpty(message = "Mobile number cannot be null or empty")

@Pattern(regexp = "($|[0-9]{10})", message = "Mobile number must be 10 digits")

private String mobileNumber;

…

}  
  
Now when this validation fails, we need to send message about the error so they know which data is wrong.  
jakarta.validation.constraints this is the package which contains many other validations which you can configure.  
  
package com.eazybytes.accounts.dto;

@Data

public class AccountsDto {

@NotEmpty(message = "Account number cannot be null or empty")

@Pattern(regexp = "($|[0-9]{10})", message = "Account number must be 10 digits")

private Long accountNumber;

@NotEmpty(message = "Account type cannot be null or empty")

private String accountType;

@NotEmpty(message = "Branch address cannot be null or empty")

private String branchAddress;

}  
  
Once putting the validation annotations, we need to go the place where we use these DTO classes, which is the controller classes.  
  
**Step 1**  
@Validated = This annotation will tell my spring boot framework, to perform validation on all the REST api that I have defined in this AccountsController,   
  
**Step 2**@Valid = This annotation will communicate to the spring boot framework to perform all the validation that we mentioned inside this DTO.  
  
package com.eazybytes.accounts.controller;

@RestController

@RequestMapping(path = "/api", produces = MediaType.APPLICATION\_JSON\_VALUE)

**@Validated**

@AllArgsConstructor

public class AccountsController {

@PostMapping("/create")

public ResponseEntity<ResponseDto> createAccount**(@Valid** @RequestBody CustomerDto customerDto)

{

…

}

@PutMapping("/update")

public ResponseEntity<ResponseDto> updateAccountDetails**(@Valid** @RequestBody CustomerDto customerDto)

{

…

}

}

}

}  
  
  
What about the other functions which do not accept the input data with help of DTO, those functions are accepting directly the data using query parameters.

For such type of function we can directly use annotation Pattern after @RequestParam as shown below.

package com.eazybytes.accounts.controller;

@RestController

@RequestMapping(path = "/api", produces = MediaType.APPLICATION\_JSON\_VALUE)

**@Validated**

@AllArgsConstructor

public class AccountsController {

…

@GetMapping("/fetch")

public ResponseEntity<CustomerDto> fetchAccountDetails(@RequestParam

**@Pattern(regexp = "($|[0-9]{10})", message = "Mobile number must be 10 digits")**

String mobileNumber)

{

…

}

…

@DeleteMapping("/delete")

public ResponseEntity<ResponseDto> deleteAccountDetails(@RequestParam

**@Pattern(regexp = "($|[0-9]{10})", message = "Mobile number must be 10 digits")**

String mobileNumber)

{

…

}

}

So now we have defined all the validations that needs to be performed.  
We have also let spring boot framework what it must do when ever these validations fail and set the messages.  
  
What spring boot framework does not know yet is how to set these messages inside the response body of the ErrorResponseDto.  
  
@ControllerAdvice

public class GlobalExceptionHandler **extends ResponseEntityExceptionHandler** {

….

@Nullable

protected ResponseEntity<Object> handleMethodArgumentNotValid(MethodArgumentNotValidException ex, HttpHeaders headers, HttpStatusCode status, WebRequest request) {

return this.handleExceptionInternal(ex, (Object)null, headers, status, request);

}

inside our GlobalExceptionHandler.

package com.eazybytes.accounts.exception;

@ControllerAdvice

public class GlobalExceptionHandler extends ResponseEntityExceptionHandler {

….

@Override

protected ResponseEntity<Object> handleMethodArgumentNotValid(

MethodArgumentNotValidException ex, HttpHeaders headers, HttpStatusCode status, WebRequest request) {

Map<String, String> validationErrors = new HashMap<>();

List<ObjectError> validationErrorList = ex.getBindingResult().getAllErrors();

validationErrorList.forEach((error) -> {

String fieldName = ((FieldError) error).getField();

String validationMsg = error.getDefaultMessage();

validationErrors.put(fieldName, validationMsg);

});

return new ResponseEntity<>(validationErrors, HttpStatus.BAD\_REQUEST);

}

}  
  
Create empty map validationErrors  
ex.getBindingResult().getAllErrors(); = this will give me all validation error failed with field and message  
Iterate through each error and extract the fieldname and validation message and add it to the map and then add this map as ResponseEntity.  
  
POST <http://localhost:8080/api/create>  
{

    "name": "Madan Reddy",

    "email": "tutoreazybytes",

    "mobileNumber": "9823150966"

}

GET <http://localhost:8080/api/fetch?mobileNumber=9823150966545454545>

## Update audit columns **updated\_by** and **created\_by** using Spring Data

With Spring data JPA we can update these columns automatically, since all INSERT queries are created by the spring data JPA framework.  
For this we need to update the BaseEntity base entity class with some annotations as below.

package com.eazybytes.accounts.entity;

@MappedSuperclass

@Getter @Setter @ToString

public class BaseEntity {

**@CreatedDate**

@Column(updatable = false)

private LocalDateTime createdAt;

**@CreatedBy**

@Column(updatable = false)

private String createdBy;

**@LastModifiedDate**

@Column(insertable = false)

private LocalDateTime updatedAt;

**@LastModifiedBy**

@Column(insertable = false)

private String updatedBy;

}  
  
But here there is a problem, the spring data framework might take the dates from the server on which it is running.  
So framework has no idea who is creating or updating the record. So for this we need to write small logic.  
  
package com.eazybytes.accounts.audit;

import org.springframework.data.domain.AuditorAware;;

public class AuditAwareImpl implements AuditorAware<String> {

@Override

public Optional<String> getCurrentAuditor() {

return Optional.empty();

}

}  
  
We need to write the logic inside this method, so spring data framework can leverage it and update the columns created\_by and updated\_by whenever needed.  
  
package com.eazybytes.accounts.audit;

@Component("auditAwareImpl")

public class AuditAwareImpl implements AuditorAware<String> {

@Override

public Optional<String> getCurrentAuditor() {

return Optional.of("ACCOUNTS\_MS");

}

}  
  
package com.eazybytes.accounts;

@SpringBootApplication

**@EnableJpaAuditing(auditorAwareRef = "auditAwareImpl")**

public class AccountsApplication {

…

}

package com.eazybytes.accounts.service.impl;

@Service

@AllArgsConstructor

public class AccountsServiceImpl implements IAccountsService {

private AccountsRepository accountsRepository;

private CustomerRepository customerRepository;

@Override

public void createAccount(CustomerDto customerDto) {

…

//customer.setCreatedAt(LocalDateTime.now());

//customer.setCreatedBy("Anonymous");

…

}

private Accounts createNewAccount(Customer customer) {

…

//newAccount.setCreatedAt(LocalDateTime.now());

//newAccount.setCreatedBy("Anonymous");

…

}

….

}  
  
POST <http://localhost:8080/api/create>  
{

    "name": "Madan Reddy",

    "email": "tutor@eazybytes.com",

    "mobileNumber": "9823150966"

}

<http://localhost:8080/h2-console>